

Title: **The Impact of Architectural Design on Patient Safety**

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The authors of this paper propose an aggressive research program addressing the impact of architectural design on patient and staff safety. The issue of providing patient safety is profoundly significant from political, economic, and legal perspectives and incorporates research topics associated with active living environments, life-span design research, international/developing country health environment needs, evidence-based design, and practice-based research. Patient safety and staff safety is the design-related healthcare issue of our time, and for the foreseeable future. There are many reasons for this. The Center for Medicaid and Medicare Services (CMS) is implementing "payment by results," a revolutionary reimbursement policy that denies providers payment for bad outcomes related to safety, for instance, all falls, many infections, medical errors, etc. Private insurers are also expected to adopt the CMS/federal policy. This will put huge financial pressure on hospitals and nursing homes to create safer environments. Hospital staff and nurses are subject to lower back injury and needle stick injuries; nursing is more dangerous than construction work.

The topic of patient and staff safety is multidisciplinary by nature, and draws on the expertise of the academically diverse faculty fellows in the College of Medicine/College of Architecture's Center for Health Systems & Design. It is in alignment with the strategic plan of the College of Architecture in that it supports one of the college's signature programs – health design and research. A recent faculty recruitment program unearthed a half dozen experts who would have made excellent contributions to the center's teaching and research missions, but unfortunately the college only had the budget to hire one assistant professor. The physical plant of the Center for Health Systems and Design is currently fully utilized, and an additional 4 faculty offices and a support staff bullpen will be needed to accommodate a full research team.

The detrimental impact of frequent medical errors and unsafe conditions in hospitals was clearly articulated in two publications by the Institute of Medicine (IOM): *To Err is Human* (1999, 2000) and *Crossing the Quality Chasm* (2001). The IOM reported that as many as 1 in 343 persons admitted to hospitals die from preventable medical events and up to 1 in 27 are subject to adverse actions. In response, the IOM articulated several goals to increase quality of care: patient centeredness, effectiveness, efficiency, safety, timeliness, and equitability.

A discussion of the financial implications of emphasizing safety in hospital environments is part and parcel to implementing a program. Clearly, there are capital costs associated with a thorough safe environment initiative. However, in addition to the humanitarian benefits of reducing suffering and mortality rates, there is a business case in support of improved facilities. Reiling (2004) notes that improved outcomes may result in lower cost per discharge and reduced length of stay, as well as salary saving associated with increased staff efficiency. Prevention of staff injuries will have a return on investment at a time of persistent staff shortages. Research is needed regarding the quantification of the economic benefits.

One of the most widely published experts on this topic, John Reiling, comments that there has been no significant research on the effect of facility design on patient safety (Reiling & Chernos, 2007). While this is true with regard to the analysis of the impact of the accumulated safety interventions of individual hospitals, research which addresses individual components of the environment and their impact on patient safety outcomes is common. Joseph and Rashid (2007) summarize research on hospital safety by dividing it into three categories: 1) research which has a direct impact on patients, 2) the impact of the environment on staff working conditions, which in turn impacts patient safety and 3) environmental barriers to safety.

Patient Safety

Joseph and Rashid have reviewed studies, which provide evidence for the following:

- the positive impact of single-bed rooms on the reduction of nosocomial infections,
- the negative impact of poor air quality on nosocomial infections,
- the negative impact of poor lighting conditions on patient mental health and physiological status,
- the negative impact of poor lighting conditions on medication errors, and
- the negative impact of noise on patient sleep and mental health.

Staff Ability to Deliver Safe Patient Care

Regarding the influence of the environment on staff working conditions, which impact patient safety, Joseph and Rashid (2007) cite studies that suggest that:

- the use of variable acuity rooms results in fewer transfers, medication errors and falls
- unit layout can reduce walking, and
- noise can increase stress, fatigue and burnout in nurses.

Other Research on the Impact of the Environment on Safety

Other research which relates to the negative impact of the environment addressed by other authors includes:

- *The environment and staff fatigue.* Studies suggest that fatigue has a negative effect on cognitive performance, mood, alertness, and ability to cope (e.g. Onen, et al., 2001, which may result in medical errors. While most studies focus on the impact of extended work shifts or sleep deprivation, which are operational issues rather than architectural issues, several organizations and researchers have underlined the negative impact of noise on fatigue (e.g., US EPA, 1978; Buß & Friesdorf, 2007; Melamed & Bruhis, 1996). Morrison, et al. (2002) noted negative physiological stress in nurses exposed to noise levels while conducting care tasks. Apart from the negative impact of noise, Shepley and Davies (2003) found that particular unit configurations can increase walking distance, which may also contribute to fatigue.
- *Negative impact of noise on communication.* Data regarding the negative impact of noise on communication and work tasks is widely available.
- *Inappropriate alarm technology.* Regarding technology, a recent study monitored the use of telemetry and pager systems and developed a two-way, voice activated hands-free communication technology that resulted in reduced alarm response times from 9.5 minutes to 39 seconds (Gieras & Ebben, 2007).
- *Bariatric patients and falls.* Although it has been reported that the physical environment does not cause falls (Dyer, 2000) studies have shown that standard bed equipment (e.g. bedrails, Boocock, Weyman & McIlroy, 2006) may fail under conditions of extreme weight.

Staff Safety

Although the primary focus of the proposed research is on patient safety, studies on the impact of the physical environment on staff safety are available. These studies focus primarily on the ergonomics of the environment (e.g. Nelson, et al., 2007). Safety of staff has been associated with back injury, electricity, pressure changes, violence, radiation, noise, and building-related illness (Behling & Guy, 1993). Kornecki (1994) notes the following events which negatively impact staff: patient falls, cardiac arrest, patient size, the need to transfer physically dependent patients between beds and equipment, and working around the limited confines of hospital beds, bathrooms and equipment.

Gurses and Carayon (2007) asked nurses to identify obstacles, which undermined staff ability to focus on patient safety. Although several researchers have reported on the positive impact of the presence of families on patient safety due to their ability to provide additional surveillance (Reiling & Charnos, 2007), the respondents to the Gurses and Carayon study mentioned family tasks as impediments to patient safety.

The proposed research endeavor will prioritize the most pressing issues regarding the impact of the physical environment on patient and staff safety and gather qualitative and quantitative data that will inform the design process associated with the development of healthcare facilities.

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